Gas Pressure Gauge Based on Alpha-Particle Induced Ion Currents

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The use of ionization currents for measuring pressure was first demonstrated in the late '40s by Dick, Falk-Vairant and Rossel. The early gauges operated at high voltages (sometimes in the kilovolt range) and used rather large ion sources (sometimes in the Ci range). Further development of this concept seems to have remained dormant for their are no known commercially available pressure gauges based on this concept.

The ionization gauge is actually a densitometer that is sensitive to the nature of the gas in the chamber, gas temperature and gas pressure. We found that the principles of operation scale to much lower source strengths (1 μCi) and to much lower voltages (<5 V). The size of the chamber can be small for our prototypes have a linear dimension of 1 cm. Since the gauge has no moving parts, it is robust. These characteristics make this approach suitable for transport to the surface of Mars via a hard lander and allow the measurement of Martian pressures which are near 7 mb.

The key to the operation of an ionization chamber as a pressure gauge is that the particles must encounter a "wall" before reaching end-of-range. The initial device was based on a converted ion gauge with a circular geometry and a 1-μCi Am-241 source. The "wall" in this case was the wire-cage anode that directed the positive ions toward the cathode or to the grounded metal enclosure where they did not contribute to the ion current. The next device has a planar geometry where the metal anode presents a physical barrier to the ions. The physical arrangement of the planar gauge is shown in Fig. 1.

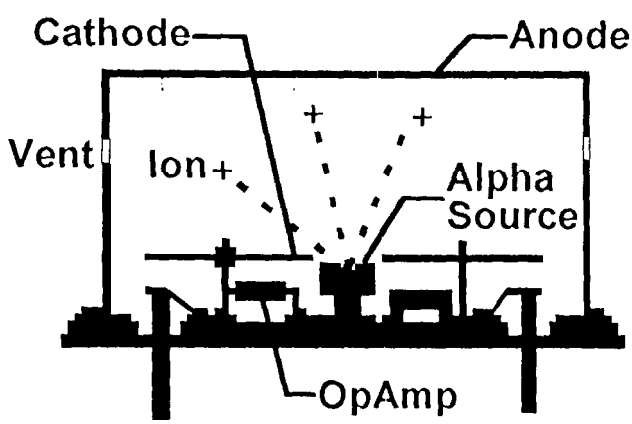

Figure 1. Gas pressure gauge based on ion currents created by the Am-241 alpha particle source,

The operation of such gauges with a 1-μCi Am-241 source depends heavily on "the use of operation amplifiers with an input current of 1 fA. At normal pressures of 1000 mb, the ion current is about 10 pA. Thus, by using fA Op Amps, pressures in the 1 mb range are easily detected. At this time we think it is feasible to construct a device that has is a volume of 2 cm^3, weight of 10 g, operating power of 1 mW, and anode voltage of < 5 V, and error of c 1 percent.

Main Topic: Physical Sensors (4)
File: PRES5515.DOC

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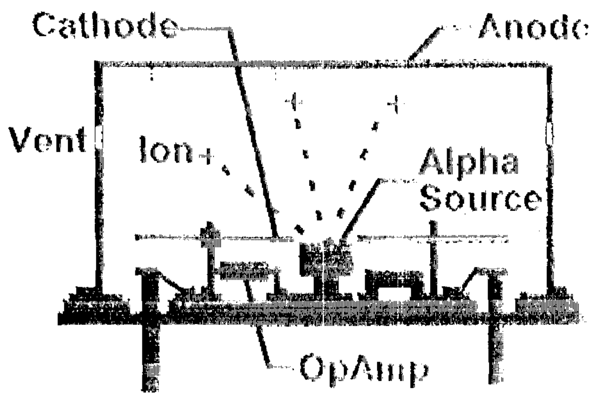

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Chart1

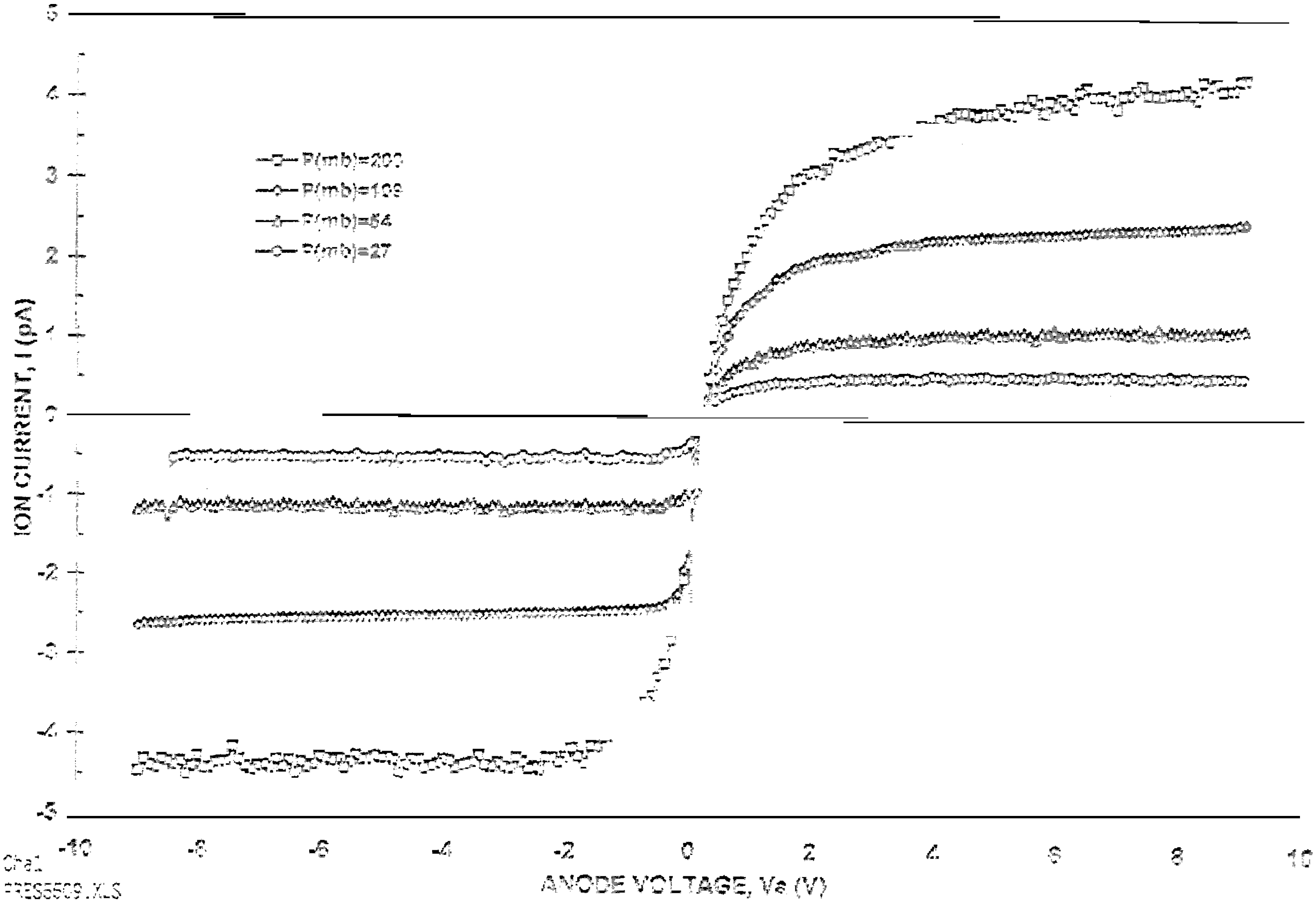

Chart1
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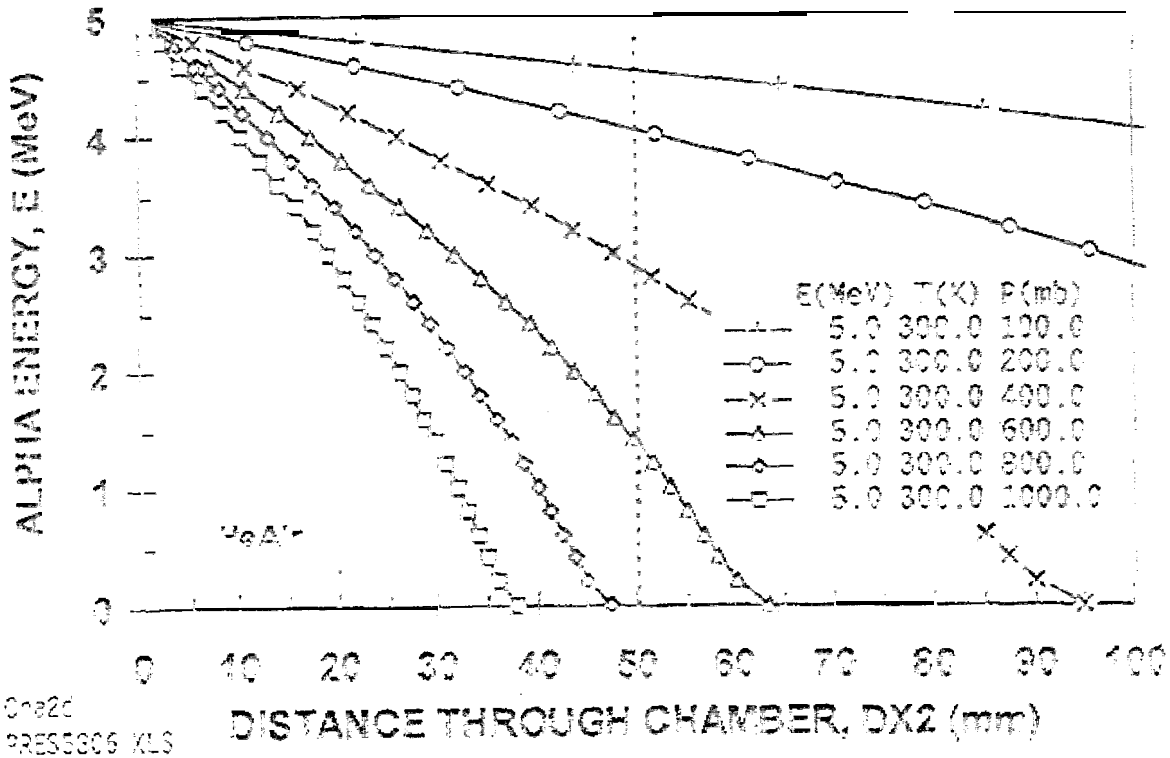
ALPHA-PARTICLE GAS PRESURE GAUGE

Alpha Particle Energy Loss Through Chamber



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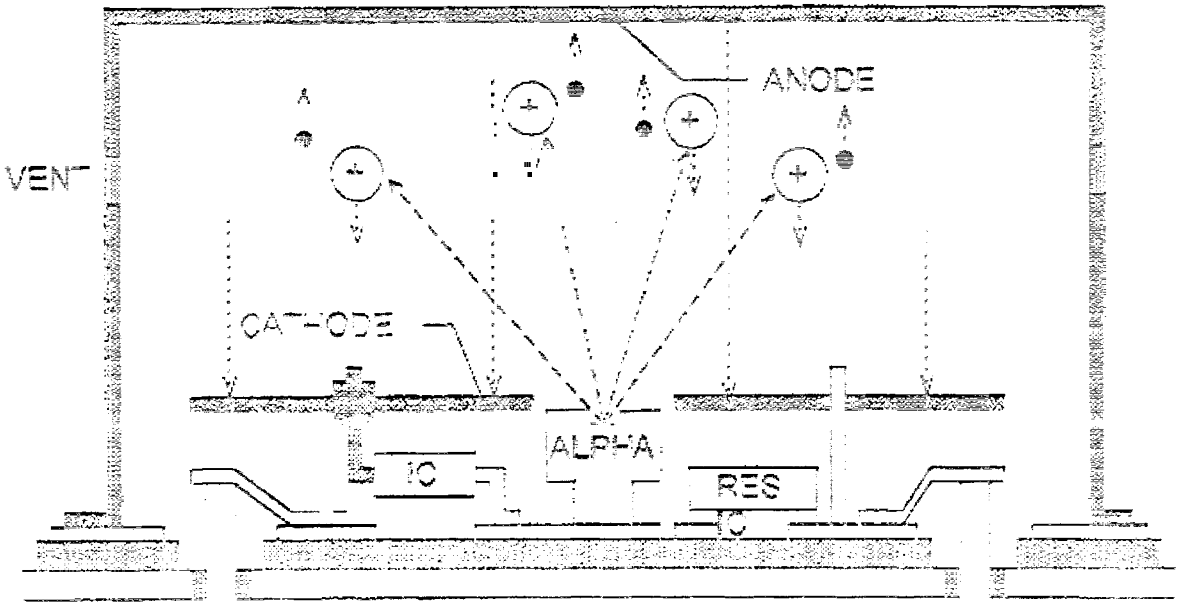
ALPHA-PARTICLE GAS PRESURE GAUGE

Smoke-Detector Configuration



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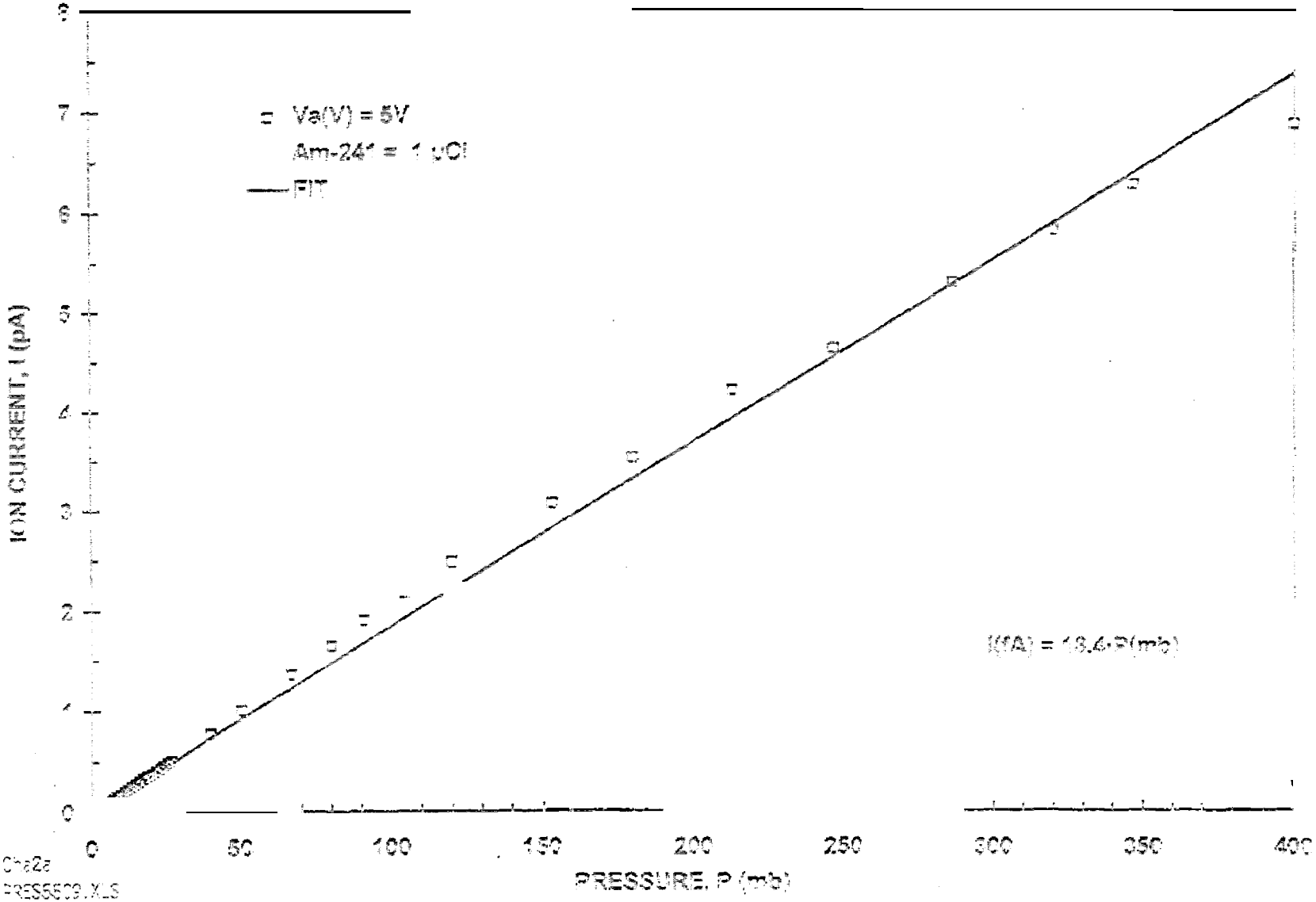

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